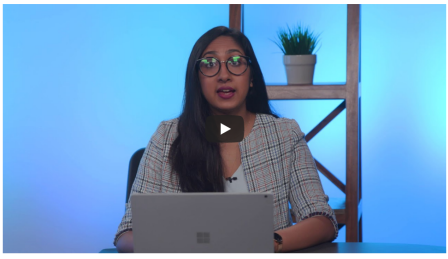
Parametric vs. Non-parametric

Based on the assumptions about the *shape* and *structure* of the function they try to learn, machine learning algorithms can be divided into two categories: **parametric** and **nonparametric**.



Parametric Machine Learning Algorithms

Parametric machine learning algorithms make assumptions about the mapping function and have a *fixed* number of parameters. No matter how much data is used to learn the model, this will not change how many parameters the algorithm has. With a parametric algorithm, we are selecting the form of the function and then learning its coefficients using the training data.

An example of this would be the approach used in linear regression algorithms, where the simplified functional form can be something like:

$$B_0 + B_1 * X_1 + B_2 * X_2 = 0$$

This assumption greatly simplifies the learning process; after selecting the initial function, the remaining problem is simply to estimate the coefficients B0, B1, and B2 using different samples of input variables X1 and X2.

Benefits:

- **Simpler** and **easier** to understand; easier to interpret the results
- **Faster** when talking about learning from data
- **Less training data** required to learn the mapping function, working well even if the fit to data is not perfect

Limitations:

- **Highly constrained** to the specified form of the simplified function
- **Limited complexity** of the problems they are suitable for
- **Poor fit** in practice, unlikely to match the underlying mapping function.

Non-parametric Machine Learning Algorithms

Non-parametric algorithms do not make assumptions regarding the form of the mapping function between input data and output. Consequently, they are free to learn any functional form from the training data.

A simple example is the K-nearest neighbors (KNN) algorithm, which we'll discuss in more detail later in the course. KNN does not make any assumptions about the functional form, but instead uses the pattern that points have similar output when they are close.

Benefits:

- **High flexibility**, in the sense that they are capable of fitting a large number of functional forms
- **Power** by making weak or no assumptions on the underlying function
- **High performance** in the prediction models that are produced

Limitations:

- **More training data** is required to estimate the mapping function
- **Slower** to train, generally having far more parameters to train
- **Overfitting** the training data is a risk; overfitting makes it harder to explain the resulting predictions

QUESTION 1 OF 3

Which of these sentences are true statements about Machine Learning? (Select all that apply.)

- [ ] Parametric machine learning algorithms are most suitable for solving more complex problems—as opposed to nonparametric algorithms, which work great in low-complexity scenarios.
- [x] When there is less training data available, simplifying the form of the mapping function to a linear regression model would be the way to go.
- [x] Non-parametric algorithms do not make assumptions regarding the form of the mapping between input data and output, so they are free to learn any functional form from the training data.

SUBMIT

QUESTION 2 OF 3

For the characteristics listed below, see if you can categorize each of them as being more true about *parametric* or *non-parametric* algorithms.

Submit to check your answer choices

CHARACTERISTIC	PARAMETRIC OR NON-PARAMETRIC?
Slower to train, generally having far more parameters	Non-parametric
Simpler and easier to understand; easier to interpret the results	Parametric
Suitable for problems of limited complexity	Parametric
High flexibility; capable of fitting a large number of functional forms	Non-parametric

SUBMIT

QUESTION 3 OF 3

Which of the following algorithms are parametric?

(Select all that apply.)

- [ ] Decision tree
- [x] Logistic regression
- [ ] KNN
- [x] Multiple linear regression

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